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(54) WRAPPING MACHINE, FOR WRAPPING CYLINDRICAL OBJECTS

(71) I, STIG AXEL ODELBERG, a Swedish Subject of Box 259, Hovas, Sweden, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to means for wrapping cylindrical objects, using a wrapper in the form of a continuous web of material, the object to be wrapped, being caused to rotate and to be enveloped along its rotating cylindrical surface with a severed portion of the web. The invention has a particularly useful but not exclusive application in a machine for automatically wrapping paper rolls using a web of wrapping paper.

In order that rolls of paper can be handled and transported in the form in which they are delivered from the paper making machine without damaging the paper, it is necessary to wrap the rolls with a protecting material. The paper rolls are normally wrapped with a protective paper wrapper which, in suitably adjusted lengths, is wound a number of turns around the cylindrical surface of the paper roll and its end portions adhered to the immediately proceding turn, whereafter the edge portions of the wrapper projecting beyond the ends of the roll are folded against end-protecting members previously placed in position on the roll, whereafter the wrapper is sealed by pressing outer end rings onto the end-protecting members.

In the case of high capacity paper making machines, the paper rolls produced thereby must be wrapped at a rate corresponding to the production rate of the machines, which necessitates an automatically operating, high capacity wrapping machine. Such wrapping machines normally operate in a manner whereby the roll of paper to be wrapped is brought to a working position in the machine by means of suitable conveying means and caused to rotate around its long axis by suitable means, whereafter a paper web is passed from a magazine in the machine towards the paper roll and wrapped around the same. The wrapping paper is unwound from storage rollers arranged in the magazine. To ensure that the paper rolls are wrapped at the high rate required, the wrapping paper must be fed to the rolls at a relatively high speed, which is liable to cause problems when severing the wrapper from the web of wrapping material. Each new wrapper should be guided in a positive and reliable manner to the paper roll to be wrapped. Furthermore, it should be possible to switch quickly and easily from one web of wrapping material to another, when paper rolls of different sizes are to be wrapped.

According to the present invention there is provided a wraping machine for wrapping a web of wrapping material around a cylindrical object, wherewith the web is passed from a supply roll over guide means, feed means and web cutting means to the periphery of the object and a severed portion of the web is wrapped therearound characterized by a number of elements arranged in the feed path of the material web and including a rotatable storage roll carrying the web of wrapping material and provided with braking means, guide means arranged to guide the web from the storage roll by means of an air flow, a first pair of cooperating, brakable rolls for advancing the web and holding the same in a stationary condition, a web cutting means including a guide portion over which the web is passed while its feed direction is simultaneously changed, and a knifie means arranged at the guide portion, the knife being arranged to sever the material web transversely of the longitudinal direction thereof at the guide portion when contact is made with said web at the cutting moment, whereafter the web and the knife immediately return to their respective starting positions, a second pair of web feeding rolls, air nozzles producing an air flow for guidingly passing the web to the periphery of the object to be wrapped and belt-like guide means adapted to move along said object in the peripheral direction thereof

whilst the object rotates for winding the web about the object, therewith subsequent to being braked and stretched by the first pair of rolls or the storage roller at the cutting moment, the web continues to move in its changed feed direction and the portions of said web situated in front of and behind the cutting line are free to move unhindered in the feed direction without folding of the web.

The invention will now be described with reference to an embodiment thereof illustrated in the accompanying drawings, of which

Fig. 1 is a diagrammatic side view of a wrapping machine constructed in accordance with the invention, including storage reels and a paper roll to be wrapped.

Fig. 2 illustrates diagrammatically the passage of the wrapping material through the machine illustrated in fig. 1, showing the units cooperating with said web, in an enlarged scale, and

Fig. 3 illustrates diagrammatically and in enlarged scale the cutting members of the cutting means in different working positions, and also the feed means located before and behind said cutting members.

As will be seen from fig. 1, the machine includes a frame 1 resting on a support surface 2, along which the objects to be wrapped are passed. In its centre position 1a, the frame 1 supports means for cutting the web of material and feed means cooperating with said cutting means. On either side of the centre portion 1a are supported a number of supply rolls 4 of wrapping material. In the exemplary embodiment, the machine is provided with three such supply rolls on each side of the centre portion 1a, although it will be understood that any number of supply rolls may be provided. Each supply roll 4 is journalled in bearings 6, the bearings being arranged on either side of the roll and provided with braking means. These braking means can be adjusted to exert a relatively small braking effect while the wrapping material is being unwound from the supply roll, thereby maintaining the extending web under tension, and a larger braking effect to be applied when cutting the web, as hereinbefore described. Located beneath the material web 5 extending from the supply roll 4 are guide and conveying means in the form of straps, belts or the like which extend under the web. The straps are provided with nozzles through which air is blown so as to obtain a web supporting and web transporting stream of air in the feed direction of the web. The air stream thus created is arranged to move the leading end portion of the web extending from the supply roll 4 into the machine. Subsequent to the web being gripped by the web feed means, to be hereinafter described, it is held stretched between the roll 4 and said feed means without the need of support. Neither is it necessary to move the web by means of the mentioned flow of air once the web is gripped by the web feed means, and consequently the supply of air to the nozzles is cut off when this stage has been reached.

The web of wrapping material is then passed in between the rolls of a first pair of rolls 8 arranged in the centre portion 1a of the machine. As will be seen from fig. 1, the web extends substantially horizontally between the supply roll 4 and the rolls 8. The lower roll in the pair of rolls 8 suitably comprises a roll having a continuous cylindrical surface and extending across at least the whole width of the web. The upper roll of the pair of rolls 8 may, on the other hand, be divided into a number of short, separate roll members, thereby facilitating manual insertion of the web between the rolls. The lower roll is a driven roll provided with means whereby the driven roll can be quickly braked, for example by means of a braking motor or some other separate braking means. Braking of the lower, driven roll is synchronized with the braking of the storage roll 4 and is not as heavy as that of said storage roll. The web is passed from the first pair of rolls 8 over the web cutting unit 9 and is guided by the guide portion 10 (fig. 3), which includes a support plate 18 having a downwardly curved end portion 19.

In the exemplary embodiment the guide portion is hinged about a shaft 20 and the web is deflected over the end portion of the support plate 18 from substantially a horizontal direction to substantially a vertical one. Included in the web cutting unit is the knife 11, which extends in a plane substantially at right angles to the infeed direction of the web towards the cutting unit and which has a flat surface 22 facing the feed direction of the web. The edge of the knife 11, which may be straight or serrated, is so situated in relation to the guide portion 10 that the edge of the curved end portion 19 of the guide portion passes immediately in front of the surface 22 when the guide portion is swung about its pivot pin, the knife edge and the edge of the curved end portion 19 being then parallel with each other. The knife 11 is securely mounted on a holder 29 in the frame 1 while connected to the guide portion 10 is a doctor device 23 which is arranged to move across the surface 22 of the knife and which is urged into contact with said surface by means of a spring 24. As the guide portion 10 moves about its pivot point, the doctor device 23 alternatively passes over the edge of the knife 11 to remove residues of the web adhering thereto and back beneath said edge. The coupling between the guide portion 10 and the doctor device 23 is diagrammatically illustrated in the form of a link 25 which connects the guide portion with a casing 30 which is movable together with the doctor

device 23 and guided (not shown) along the knife. It will be understood, however, that the illustrated coupling is not in anyway restrictive, but may be given any appropriate form.

The manner in which the cutting means operates is described with reference to fig. 3, which for the sake of clarity shows three of the cutting units in the machine in different working positions. It will be understood, however, that each cutting unit can take each of the shown working position, although only one cutting unit will be in effective operation at any one moment during a machine working sequence. In position A, the guide portion 10 is in the feed position for the web of wrapping material, the web extending over the curved edge portion 19 of the support plate 18 so that the feed direction of the web is changed from a substantially horizontal one to a substantially vertical one. The web 5 is drawn downwardly in the direction of the arrow by a second pair of rolls 12. When the web is to be cut, movement of the pair of rolls 8 is braked and the heavier braking of the supply roll 4 is effected synchronously therewith. At the same time the guide portion 10 is swung by means not shown in a clockwise direction (when considered from the position A in fig. 3), wherewith the web is moved in a direction towards the edge of knife 11 to the position B (fig. 3) during continued movement vertically downwardly behind the cutting unit. When the web meets the edge of knife 11 it is severed and continues to move downwards under the influence of the rolls 12. At the moment when the web is cut, the support plate 18 is situated slightly below the plane of the web through the knife edge. Although the rolls 8 are braked relatively quickly, there is a certain amount of sluggishness or inertia with respect to the movable parts, which causes the end portion 17 of the web to be fed slightly beyond the edge of the knife 11 subsequent to separating the vertical portion of the web. Immediately after the web has been cut, the guide portion 10 is swung back in a counterclockwise direction (considered from the position A and C in fig. 3) to take the position shown at C. In this position, the end portion 17 of the web is seen to extend slightly beyond the edge of knife 11. This "secondary" feeding of the web beyond the cutting position, caused by the unavoidable sluggishness of the moving parts, has no deleterious effect, however, since the web is able to move freely and is thus not subjected to folding. During the return movement, the doctor device is moved past the edge of knife 11 to the starting position for feeding and scraping the edge, as shown at A.

The cutting unit shown at position B is allochiral to the cutting units in positions A and C, and hence the directions "clockwise" and "counterclockwise" are in this instance reversed with respect to the figure.

In the above described embodiment of the cutting means, the guide portion 10 is movable and the knife 11 stationary. It will be understood, however, that a corresponding relative movement between the web and the knife can be obtained by fixing the guide portion in an unchanged position and arranging the knife for movement against the web. In this case, the doctor device is suitably stationarily arranged. Subsequent to severing the web, the knife is immediately returned to its starting position, so that in a manner corresponding to the embodiment first described the end portion 17 of the web is free to pass unhindered past the cutting position under the influence of the inertia of the moving parts of the machine created when braking rolls 4 and 8. When cutting the web, it is also possible to brake the web movement solely by means of the heavier braking caused at the supply rolls 4, whereby the braking means cooperating with the driven roll 8 can be disengaged.

The separated portion of the web, i.e. the wrapper, is moved vertically downwards by the rolls 12 for continued wrapping of the object 3 (paper roll), wrapping of the object having been commenced prior to the cutting of the web. Located beneath the pair of rolls 12 is a means 28 for applying adhesive to the side of the wrapper facing the object 3. The adhesive applying means is of conventional design and consists of rollers for transferring adhesive from a container to the wrapper.

The cylindrical object 3 rests on two rotating rollers 27 which are located in the plane of the support surface 2 and which cause the cylindrical object to rotate in a clockwise direction (as seen in fig. 1) about its long axis. The arrangement is such that the vertical extension of the web of wrapping material is directed substantially towards the peripheral surface of the object in its direction of rotation. Subsequent to wrapping the wrapper around the object 3 which wrapper is cut to a predetermined size according to the required number of wrapping turns about the object, the edge portion of the wrapper is secured by bonding it to the nearest preceding turn on the cylindrical surface of the object, whereafter the wrapped object is ready to be transported to subsequent treatment stations. Whilst the object is being wrapped, the web of wrapping material is guided towards the object by means of belts 14, 15 which can be moved downwards out of the path of the object to be wrapped during its passage to and from the wrapping station in the wrapping machine.

The means for drawing a fresh portion of the web into the machine to commence the wrapping of the next object and the means for commencing said wrap-

ping operation constitute another important part of the present invention. When the web of wrapping material has been passed from a supply roll 4, as described above, through the first pair of rolls 8 and is located in the position C subsequent to a wrapped portion of the web having been cut, a new feeding sequence can be initiated. This is done by restarting the rolls 8 so that the web is moved forwards down towards the vertical partition 31 situated opposite and vertically above the nip of the rolls 12. At the same time a stream of air is blown downwards along a partition 31 through the nozzles 13, which are arranged thereon; whereupon the web is moved downtowards the rolls 12. In order to facilitate guiding of the vertically extending portion of the web in the nip of the rolls 12, belts 26 arranged to converge towards the rolls can be passed around said rolls for movement therewith. When the end portion 17 of the web has been gripped in the nip of the rolls 12, the web is moved down towards the periphery of the next object to be wrapped, placed in working position on the rolls 27, and is moved in between the belt 14, which has been swung in towards the object, and the object 3. To facilitate guiding of the web to the peripheral surface of the object, air is blown through nozzles 21 (fig. 1 and 2) vertically downwardly along the side of the web facing the object, whereby an aerodynamic guiding of the end portion of the web towards the periphery of the object is obtained by the subpressure formed between the web and the object. This air stream is also used to guide the web downwardly at a greater speed than that corresponding to the falling speed of its forward portion in the ambient air, so that the forward portion of the web is drawn by the stream of air in the feed direction and the web is not deflected laterally. The web is wound around the object whilst the object is rotating, and is guided by the belts 14 and 15, which have been swung up towards the object. The belt 15 guides the web upwards during its peripheral movement and extends along the periphery to a point above the centre of the object, so as to reliably lead the end portion of the web around the object. This relatively complicated guiding of the web around the object has particular importance at high web speeds, the problem often arising of obtaining sufficiently snug contact between the web and the object. The different sequences described above are suitably programmed for electric program control. One machine working cycle includes the following steps: an object to be wrapped is rolled to the working position of the machine and placed on the rollers 27. The web guide belt 15 is then swung down beneath the support surface 2. The machine is provided with storage rolls 4, it being assumed that respective webs have been drawn forward to position C. The program is then started for the web 5 being used. The belt 15 is swung in to its effective working position and the rolls 8 are started and a light braking force applied to the storage roll 4, so as to hold the web in tension. At the same time, air is blown from the nozzles located on the same side of the partition 31 as the web of wrapping paper being used, and the pair of rolls 12 are started. When the end portion 17 of the web has been gripped by the rolls 12, air to the nozzles 13 is interrupted. The rolls 27 are started to rotate the object 3 and, simultaneously, air is blown through the nozzle 21 so as to guide the end portion 17 of the web towards the object to be wrapped. Supply of air to the nozzles 21 is then interrupted. The requisite number of turns of wrapping material are then made around the object 3, whereafter the web is cut, as described. When cutting the web of wrapping material, the rolls 8 are stopped and a strong braking force is applied to the storage roll 4. At the same time, the synchronized movement of the guide portion 10, alternatively the knife 11, is started and the web is cut. The cut portion of the web, i.e. the wrapper, continues its forward, downward movement, while the guide portion returns to position A. Upon passing the arrangement 28, the arrangement 28 is caused to engage the end portion of the wrapper and then returned to its rest position. The rolls 12 are then stopped. The wrapper is then wound around the object, whereafter the rolls 27 are stopped and the belts 14, 15 swung down beneath the support surface 2. The object 3 is now ready to be rolled along the support surface 2 to the next treatment station.

The web severing arrangement of the illustrated machine enables a wrapper to be cut from a rapidly moving web of wrapping material without folds to be formed in the web. The tendency of the web to form folds when being cut often gives rise to difficult problems. Such folds are difficult to avoid if, as is commonly the case, the web is held stationary, while being cut, in a cutting means which has two co-operating knife edges. When brought to a rapid stop against such knife edges, the web is unavoidably folded or crumpled. These folds make it difficult to feed the web in the next wrapping sequence. Another important advantage of the illustrated machine is that it enables the change from one size of wrapper to another to be made quickly and smoothly, the new wrapping portion of the web being guided positively and quickly into position.

Although the invention has been particularly described above in relation to a machine for use in wrapping paper rolls with a paper wrapper, it will be understood that wrapping machines according to the present invention can be used to wrap other

cylindrical objects with a material other than paper.

WHAT WE CLAIM IS:—

1. A wrapping machine for wrapping a web of wrapping material around a cylindrical object, wherewith the web is passed from a supply roll over guide means, feed means and web cutting means to the periphery of the object and a severed portion of the web is wrapped therearound, characterized by a number of elements arranged in the feed path of the material web and including a rotatable storage roll carrying the web of wrapping material and provided with braking means, guide means arranged to guide the web from the storage roll by means of an air flow, a first pair of cooperating, brakable rolls for advancing the web and holding the same in a stationary condition, a web cutting means including a guide portion over which the web is passed while its feed direction is simultaneously changed, and a knife means arranged at the guide portion, the knife being arranged to sever the material web transversely of the longitudinal direction thereof at the guide portion when contact is made with said web at the cutting moment, whereafter the web and the knife immediately return to their respective starting positions, a second pair of web feeding rolls, air nozzles producing an air flow for guidingly passing the web to the periphery of the object to be wrapped, and belt-like guide means adapted to move along said object in the peripheral direction thereof whilst the object rotates for winding the web about the object, wherewith subsequent to being braked and stretched by the first pair of rolls or the storage roller at the cutting moment, the web continues to move in its changed feed direction and the portions of said web situated in front of and behind the cutting line are free to move unhindered in the feed direction without folding of the web.

2. A wrapping machine according to claim 1, characterized in that the movable guide member is adapted to pass the web into engagement with the stationary knife to separate web.

3. A wrapping machine according to claim 1, characterized in that the knife is arranged for movement into contact with the web guided over the stationary guide portion to sever the web.

4. A wrapping machine according to claim 1, characterized in that the guide means comprise guide belts which are arranged substantially horizontally beneath the web and which are provided with air nozzles adapted to train jets of air in the feed direction of the web, thereby providing a supporting and transporting air stream.

5. A wrapping machine according to claim 1, characterized in that the storage roll and the first pair of rolls are capable of being braked at the moment of cutting the web.

6. A wrapping machine according to claim 1, characterized in that only the storage roll is braked at the moment of cutting the web.

7. A wrapping machine according to claim 2, characterized in that the guide portion comprises a web supporting plate which extends in the web feed direction upto the knife and which, at its end portion adjacent the knife is curved in the changed feed direction of the web and hinged about a pivot pin extending transversely of the feed direction and located in front of the knife, whereby the guide plate when pivoted about its pivot point guides the material of web against the edge of the knife with its end edge parallel with the cutting plane of the knife.

8. A wrapping machine according to claim 7, characterized in that the knife has a flat surface which faces the feed direction of the web and is substantially perpendicular thereto, a movable doctor means urged against said surface by spring means and adapted to move in a direction towards and away from the cutting edge of the knife and beyond said edge and being connected for movement with said guide portion.

9. A wrapping machine according to claim 1, characterized in that means are provided before the web cutting means for guiding the web substantially horizontally and for guiding said web subsequent to changing the feed direction thereof substantially vertically downwards from said cutting means.

10. A wrapping machine according to claim 9, characterized in that air nozzles are provided, said air nozzles being adapted to blow a stream of air along the vertical portion of the material web behind the clipping means so as to entrain the new end portion of the web obtained when cutting the web in a downward direction.

11. A wrapping machine according to claim 10, characterized in that the second pair of rolls is arranged beneath the cutting means on horizontal shafts so as to present vertical feed gap for receiving the vertically extending portion of the web, belts which converge towards the rolls being passed around said rolls for movement therewith, so as to facilitate guiding of the end portion of the web between said rolls.

12. A wrapping machine according to claim 1, characterized in that the guide and feed means include air nozzles arranged behind the second pair of rolls and adapted to blow a vertical stream of air downwardly along the side of the web facing the object to be wrapped, thereby to lead the web in the feed direction downwardly at a greater speed than its normal falling speed and thereby to guide aerodynamically the end portion of the material web towards the periphery of

the object by the subpressure formed between the web and the object.

13. A wrapping machine according to claim 9, wherein the cylindrical objects rests on rotatable rollers for rotating the object and are so positioned that the vertical portion of the web extends substantially to the periphery of the object in its direction of rotation, characterized by guide belts which can be swung towards the object to be wrapped and which have a portion which is movable along the periphery of the object at at least the speed of the web so as to guide the web along said objects, said belts being arranged to take up the end portion of the web at their vertical input side adjacent the object in a downward direction and to pass the web on the opposite side of the object upwards over the longitudinal centre line of said object.

14. A wrapping machine according to any of the preceding claims, characterized in that means are provided behind the second pair of rolls for applying an adhesive to the rear end portion of the cut wrapper.

15. A wrapping machine according to any of the preceding claims, characterized in that the web is unwound and wound in the same direction during its passage through the machine.

16. A wrapping machine according to any of the preceding claims, characterized in that a plurality of storage rolls having associated guide and clipping means are arranged for alternative infeed of different material webs to the second pair of rolls and then to the object.

17. A wrapping machine for wrapping a web of wrapping material around a cylindrical object, substantially as hereinbefore described with reference to the accompanying drawings.

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Fig. 1

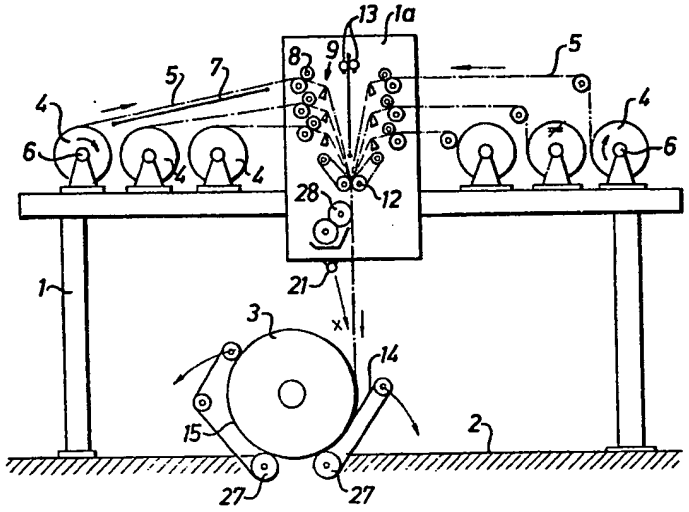

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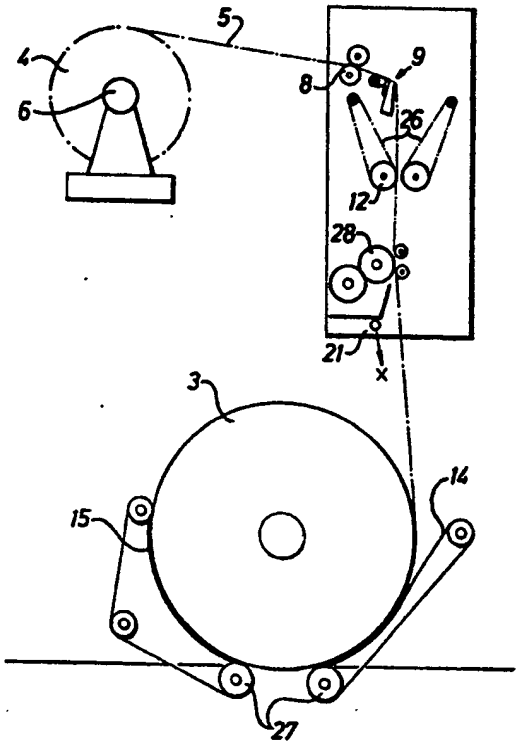
Fig. 2



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Sheet 3

Fig. 3